Physics

Polarizing Shades Lab

Purpose

This lab investigates the polarization of light, a property that makes polarizing sunglasses popular. **Before** beginning the lab, write down everything you already know about why polarizing sunglasses are better. You will look at various light sources through polarizing filters and then describe how much light the filters allow to shine through. **Try to be as specific as you possibly can** in your descriptions of how the intensity of the light changes as the filters are rotated. For example, **don't** just write "it changes," or even "it gets brighter and darker." Instead, write something like "the intensity goes from 25% ⇒ 50% ⇒ 0% ⇒ 50% ⇒ 0% ⇒ 50% ⇒ 0% ⇒ 25%."

Procedure

1. Hold one of your filters between you and an overhead light, and rotate the filter slowly through 360°. **Record** what, if anything, happens to the intensity of the light as you rotate the filter.
2. Have one group member hold one of your filters between you and the light source in a **fixed** position. Have another group member hold a **second** filter **between you and the fixed filter**, and rotate the **nearer** filter through 360°. **Record** what, if anything, happens to the intensity of the light as you rotate the **nearer** filter.
3. Now try holding the **nearer** filter **fixed**, as the more **distant** filter is rotated through 360°. **Record** what, if anything, happens to the intensity of the light as you rotate the more **distant** filter.
4. Try rotating both filters **simultaneously** in the **same direction**. **Record** what, if anything, happens to the intensity of the light as you rotate the two filters **together** through 360°.
5. Rotate both filters **simultaneously** through 360° again, but this time turn them in **opposite** directions (i.e., turn one clockwise and the other counterclockwise). **Record** what, if anything, happens to the intensity of the light as you rotate the filters in **opposite directions** through 360°.
6. Sit down and discuss your results thus far with your group members. Try to come up with a description of what you think such a filter does to the light striking it, a process physicists call "polarizing" the light (Hint: part of the light is being transmitted and part is being absorbed.) **Record** your "theory of polarization," but make sure that it explains the **specific** results you got when you performed **Steps #1-5**, including the number of times that each "pattern of results" repeats.
7. Repeat **Step #1**, except this time, bounce the light from the source off a mirror **before** you send it through the filter and then into your eyes. **Record** what, if anything, happens to the intensity of the light as you rotate the filter.
8. **Do you think** that a mirror changes the polarization of the light reflected off it?
9. Look through a filter at the glare of the light skipping off the top surface of your table at a **very large** angle of incidence (**check your notes** to make sure you remember how to measure this angle). **Record** what, if anything, happens to the intensity of the light as you rotate the filter through 360°.
10. **Do you think** that the glare of light skipping off a flat surface (other than a mirror) is polarized?

11. View different regions of the sky through a filter, **but don't look directly toward the sun!** Rotate the filter through 360° as you examine each region. **Do you think** that any of the light coming from the sky is polarized? **From which direction** does the light of maximum polarization come (in relation to the sun).
12. View the liquid crystal display (LCD) on a wristwatch or calculator through a filter as you rotate the filter through 360°. **Do you think** that the light coming from an LCD is polarized?
13. Position two filters so that the **minimum** amount of light from the source makes it through them.
14. Have one group member hold those two filters between you and the light source in a **fixed** position. Have another group member hold a **third** filter **between you and the fixed filters**, and rotate the **third** filter through 360°. **Record** what, if anything, happens to the intensity of the light as you rotate the **third** filter through 360° when it's the **nearest** filter.
15. **Without changing the orientation of the two fixed filters**, move the **third** filter so that it's now **between the light source and the fixed filters**, and again rotate the **third** filter through 360°. **Record** what, if anything, happens to the intensity of the light as you rotate the **third** filter through 360° when it's the **farthest** filter.
16. Finally, **without changing the orientation of the two fixed filters**, place the **third** filter **between the two fixed filters**, but rotate it 45° before you insert it. Move the **third** filter in and out of the gap between the two fixed filters and look carefully for any changes in the light coming through. **Record** how the **third** filter, when inserted **between the fixed filters**, seems to affect the amount of light making it through, if at all. Play around other "angles of insertion" for the third filter to deepen your understanding, but there's no need to record these results. Instead, focus on what happens when it's inserted at 45°.

Analysis and Conclusions

You've already done much of your analysis and outlined your conclusion (both in **Step #6**). Develop your group's polarization theory **carefully** in your own words, and then use it to interpret your results from **Steps #7-12**. Use your results from **Step #10** to explain what polarizing sunglasses are good for and how they work. In your final lab report, use both your theory of polarization and what we study in class about it (later this week) to explain your results from **Steps #13-16**.